steps and approaches, the whole is rendered of no use by the railings. The steps to the western portico of St. Paul's Cathedral are arranged with great skill, but all is concealed by the opaque screens. The portico of the London University is quite sufficient to silence the mob, who judged of Wilkins by the National Gallery; the former has a fine flight of steps, whilst the deficiency of the latter in this particular, is the principal cause of its meanness. But you cannot see the whole of the steps to the first, unless you "tip-toe" over the pailings, or go within the privileged inclosure. Few architects give themselves the trouble to consider how much their buildings are injured by railings, which cannot be looked over. For you should not be expected to stop and pick out some eyelet hole, where you fancy there may be a favourable view; and if you do not stop, the railings run into each other like the spokes of a wheel in motion, so that you have a most impenetrable screen before you. It makes comparatively little difference whether the rails are massive or slender. In St. Paul's Cathedral two beautiful doorways to the vaults might just as well be out of the building; and we dare say, that many persons have examined the whole of the festoons and other enrichments, without discovering the doorways. When some defence is imperative, it is best, if boldly made a feature in the design, as in the balustrades to the Reform and Travellers' Clubs. Few buildings in towns have the fortunate advantage of ground descending from them, but much may be done to obviate this deficiency. If the building is not to be railed round, there is generally sufficient scope for some of the adjuncts alluded to. Either the whole front can be raised upon steps, and a massive character given to the basement, or the footway can be bounded by pedestals; sometimes the doorway and its steps can be slightly elevated, and in all cases much more may be attempted than is now thought of. We have only carefully to examine the palaces and churches of Italy, as above mentioned, to comprehend the value of that for which we contend. In fact, the success of a design depends greatly upon what, taken by themselves, may be trifles.—If it be argued, that we are compelled to adopt railings, it may at once be answered, that they are required only by the want in other places of certain conveniences, in which London is still shamefully deficient, the necessity for which has been repeatedly urged, yet is very tardily supplied.

WATER—HOUSE SUPPLY—DRAINAGE.*

The Centre of Pressure, in a surface pressed by a fluid, is a point at which a force equal to the pressure, and directly opposed to it, may be applied so as to balance or counteract it. If we suppose the bottom of a square cistern to move up and down water-tight, the point at which an upright support will apply so as to balance it, and admit no tendency to turn over upon it, will obviously be at the intersection of its two diagonals. In a rectilinear side of a cistern it is situated at two-thirds down midway in the length,—in a vertical triangular side, the two slopes of which are equal, it is three-fourths down from the vertex,—and in a triangular side with only one slope, it is in a horizontal line with three-fourths down the vertical edge, but three-eighths of the base inwards from it. Thus, in case of danger, a single prop can be brought to bear with effect, where much misapplied strength might be no better than none—perchance worse.

The discharge from cisterns, as we have stated, is rendered more or less efficient according to the height of the head of water above the orifice: this would be demonstrated by making several outlets at different heights in the side, when the uppermost jet would be languid compared with the impetuosity of the lowest. Jets of this kind obey the laws which govern the flight of solid projectiles,—describing a curvilinear motion of the parabolic order, proportional to the discharging force. The velocity of the discharge is equal to that acquired by a heavy body in falling through the height of the water above the centre of the aperture; it is, therefore, as the square root of that height, or, inversely, the height is as the square of the velocity. This proposition has been confirmed by experiments; the difference between the theoretical and real discharges, occasioned by the resistance of the air, by friction, and by the oblique motion in the rush towards the orifice, by which the particles impede each other's descent, being altogether inconsiderable. This, however, is supposing that the most favourable form of outlet is afforded; and which is ascertained to be a round hole at the bottom of the vessel, continued outward tubularly and horizontally to an extent not less than twice, or exceeding four times, its diameter, and terminating in a trumpet-shaped mouth, externally as well as internally.

When water issues through a hole in a thin plate, the stream contracts at a small distance out from the hole, is diminished accordingly, and only there acquires its natural velocity, and with a screw-like motion, which is caused by the contending influence of the descending columns. It is also found, that with a tube which, instead of being flush with the inside of the vessel, enters it to some distance, the flow of water is even less than with a simple hole without any tube; likewise that the discharge through a horizontal tube whose length does not exceed its diameter, is the same as that through a simple orifice. These phenomena will be understood by considering the effect, at the point of emission, of conflicting currents being met by interruptions; which, with their own inertia, must turn them in opposition to the descent of the more perpendicular columns, rather than facilitate their escape.

But the orifice must also be of favourable dimensions; for the friction in small tubes is very considerable,—so great, indeed, is it in one of an inch bore, that one of twice the capacity will deliver five times as much water; thus a great gain in transmission is secured by increasing the capacity of pipes, and thereby augmenting the proportion which the column in motion bears to the nearly quiescent cylinder which surrounds it, in contact with the pipe. It should be borne in mind, that the conditions most favourable for pipes are their being perfectly smooth, equal, and straight; and therefore that these conditions ought, as far as possible, to be complied with; for any eddies or reverberations formed within them will as effectually impede the progress of the water as the most solid obstacles; and thus wooden pipes will offer more obstructions than leaden ones. To compensate for retardation of the varied kinds referred to, it is not unusual to allow an addition of as much as one-third to the sectional area. The rational conclusion deduced regarding the great increase of pressure on pipes from the altitude of the column of water contained in them is, that the strength of metal should be increased downwards; and that when it is every where equal, and strong enough below, it is superfluously so above. The same reasoning applies to cisterns.

CAST-IRON PIPES are of two descriptions, socket and flanged; above 4 inch, they are all cast 9 feet long; under, down to 1¼ inch, usually 6 feet; and 1¼ inch, 4½ feet long; above, say 4 inch, they are usually sold by the ton, those below by the yard, excluding sockets. As to casting, many are content with its being done on a sloping bench, whilst others insist on its being perpendicular, and with a head of metal above the top of the pipe; it is usual, however, to run the metal directly from the blast-furnace, and not from the cupola as formerly. They are generally proved by hydraulic pressure equal to a column of water 250 feet high, and in warm weather it is desirable to use the water warm.* Practice enables a skilful prover to tell by the ring of a pipe, with a tap of a hammer, whether it is faulty, either from being cracked or deficient in thickness. From 14 to 15 inches in diameter is generally sufficient to supply a population of from 70 to 100,000.

Street pipes or mains should be laid in as straight a course as possible, their inclination also uniform, and if possible not exceeding 1 in 100; their depth below the surface of the ground should not be less than 18 inches, to guard against frost and casual disturbance by street repairs. Where descending mains meet and form an angle, syphon-pipes or receivers should be placed to collect the deposition of mud, &c. *Mains* and *sub-mains* are any leading pipes from 4 to 18 inches in diameter; smaller are *service-pipes*.

In joining flange pipes, it is usual to introduce between the flanges a wease, or washer of yarn or sheet-lead, smeared with red or white lead, which, on the flanges being brought tightly together with the screw-bolts, renders the junction perfect. For socket-pipes, the most usual mode of joining is with molten lead; a mixture of cast-iron borings and sal-ammoniac is sometimes used; but perhaps the best, not only for economy, but the quality of the joint, is an old method still followed, which consists in the use of wooden wedges, made with curved surfaces to fit the interior of the socket and exterior of the spigot ends of the pipes. Lead and iron cement being both less elastic than wood, are more liable to be blown out by a force of water; and in the case of a defect in a joint, the iron one has the objection that it cannot be beaten up like a lead one, or spiled up like one of wood, but must be made entirely afresh. In making lead joints, some gasket is first driven in tight all round, to prevent the melted lead from running into the pipe. The following have been found to be the relative costs of the three last-named methods:—

Lead	1.778,023
Iron	1.112,302
Wood	592,301

In vol. iii., p. 392, of THE BUILDER, will be found some very interesting particulars respecting the deleterious effects of water containing carbonic acid, passing through lead pipes: cisterns and pipes composed of lead, and usually so innocuous to health, it would appear, are rendered dangerous as the vehicles of water so impregnated,—the acid being sufficiently powerful to dissolve portions of the lead, in passing over its surface, to the amount of one and one-third grain in the imperial gallon: this argues in favour of the Valentia-slate cisterns which have come into use of late years.

JAMES WILSON.

* Continued from page 327, *ante*.—ERRATUM: page 327, first column, last paragraph, for "635" read "695."

* Cast-iron pipes of the following calibres have been subjected to a pressure equal to a column of water 733 feet high without bursting:—
10 inch pipe, ¾ inch thick barely.
8 inch pipe, ¾ inch thick.
and 3 inch pipe, ¾ inch thick.

AWARDS OF OFFICIAL REFEREES.

POSITION OF STEAM PIPES.

With regard to a certain building of the fourth-rate of the public building class, situate on the ground of the New River Company, in rear of the west side of George-street, Euston-square, in the parish of St. Pancras, in the county of Middlesex, and in the district of St. Pancras within the limits of the Metropolitan Buildings Act, 7 & 8 Vict., cap. 84.

The district-surveyor said:—"Whereas Mr. Thomas Harris, in fitting up the said building for the purpose for which it was erected, namely, as public baths and wash-houses, has done certain matters or things contrary to the provisions of the said Act, namely, constructed certain metal pipes for the conveyance of steam, the position of which pipes is contiguous to wooden partitions and other combustible material, contrary to schedule F of the said Act."

A certificate from two engineers, to the effect that from the arrangements made, no injury could arise from the contact of the timber with the steam pipes, was put in.

The referees awarded, "that inasmuch as the pipes in question for conveying steam, are placed within fourteen inches from woodwork, such pipes are contrary to the said Act: but inasmuch as the woodwork is not such as to endanger the rest of the building if fire were communicated to it from the said pipes, and inasmuch, moreover, as the building is one in which the risk of fire is very small, and having regard to the above-mentioned certificate, we make no direction thereon."

STAIRCASES TO PUBLIC BUILDINGS.

Amongst other alterations at the Sadler's Wells theatre, it was proposed to remove a wooden staircase leading to the boxes, and place the same elsewhere. Doubts being entertained whether or not it should be reconstructed fire-proof, in consequence of the removal, application was made to the referees, who determined that the removal of the staircase in question, and its reestablishment as proposed, will not be contrary to the Act.

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